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DECLARATION OF TRANSLATOR

I, Lawrence B. Hanlon, of the International Translation Center, Inc., do hereby avow and declare that I am conversant with the English and German languages and am a competent translator of German into English. I declare further that to the best of my knowledge and belief the following is a true and correct English translation prepared and reviewed by me of the document in the German language attached hereto.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of any patent issued thereon.

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Filter Device

The invention relates to a filter device comprising at least one filter element which can be held in a filter housing which can be connected to carry fluid by way of fluid connections to a fluid means, especially in the form of a hydraulic tank, by a connection system and which can be detachably fastened to the fluid means by a fastening means.

Filter devices of the aforementioned type are readily available on the market in a plurality of designs and versions. They are used among other purposes to filter dirt in fluids, such as hydraulic oil, out of these fluids. Hydraulic oil is fouled during installation and when the respective hydraulic system is started up, and in addition to this initial fouling, fouling during operation can occur, for example by penetration of dirt at the hydraulic tank due to inadequate tank ventilation, pipe penetrations, piston rod seals, and the like. To the extent fouling within the fluid stored in the hydraulic tank occurs in hydraulic systems of machines such as earth moving machines, excavators or the like, it can be advantageous to implement filtration directly in the region of the hydraulic tank, for example by installing the filter device directly in the tank, the hydraulic oil which is removed from the tank contents being delivered to filter out dirt directly to a filter element which is held in the filter housing, and the fluid which has been cleaned in this way then returning again to the tank contents by way of the filter housing. In these solutions, the filter device cleans only the

contents of the tank. But solutions are also conceivable in which the filter device delivers the correspondingly filtered and cleaned fluid to the hydraulic circuit of the machine, in order from there to return to the tank the fluid which is fouled also with solid particles in the pertinent circulation in the hydraulic circuit.

In the solutions in which the filter device filters only the contents of the tank by fluid being removed from the tank, filtered and then returned again to the tank contents, it can be advantageous, when the filter element has to be changed, to block off the contents of the fluid means, especially in the form of a hydraulic tank, relative to the filter housing. In this process the filter housing with the used filter element can be completely dismounted from the fluid means, specifically the tank, and replaced by a filter housing with a fresh filter element without the need to interrupt operation of the respective hydraulic system.

In the known solutions, tedious and time-consuming measures must be carried out in conjunction with changing the filter housing,. Thus, the pipes which belong to the connection system must be separated from one another and sealed tight in a complicated process. There is also the danger that larger amounts of fluid will escape from the filter housing and/or fluid means as a type of leaking oil flow when the filter housing is being dismounted; this leads to environmental pollution problems. Moreover, the actuation of the fastening means by the operator when removing and re-attaching the filter device to the fluid means must be done carefully to ensure trouble-free operation of the pertinent fluid system.

On the basis of this prior art, the object of the invention is to make available a filter device in which the measures to be carried out to change the filter element can be performed especially easily and safely, so that trouble-free operation of the pertinent fluid means is ensured. As claimed in the invention, this object is achieved by a filter device with the features specified in claim 1 in its entirety.

In that, as specified in the characterizing part of claim 1, a bayonet catch is provided as the fastening means, by means of which the filter housing can be detachably fastened to the fluid means, and in that, by rotary motion of the filter housing when the bayonet catch is being locked and released, a blocking element can be controlled which blocks and clears the pertinent fluid connection, the filter can be changed with a maximum of safety and especially simply and easily. This is achieved in that blocking and clearing of the fluid connection take place automatically when the filter housing is being mounted and dismounted; this in turn takes place in an especially simple and easy manner by releasing and locking the bayonet catch.

Based on use of a bayonet catch as the fastening means and of the automatic blocking of the fluid connections when the bayonet catch is released, all the actuation processes in conjunction with replacing a used filter element can be carried out in a few seconds, since the filter housing which contains the used filter element can be removed as a whole from the fluid means by releasing the bayonet catch without separate measures being necessary at the fluid connections of the fluid means. Likewise the attachment of a filter housing containing an unused filter element is effected in a correspondingly short period of time by locking the bayonet catch, because the fluid connections are automatically cleared by the locking process.

In embodiments which are characterized by an especially simple and compact design, the blocking element is a rotary disk valve which is pivoted on the fluid means. In this configuration the rotary motions which take place when the bayonet catch is actuated can be converted especially easily into the corresponding rotational-control motions of the rotary disk valve.

In especially advantageous embodiments, the filter housing has one valve each pretensioned into the closing position both at the inlet opening through which the fluid enters the dirty side of the filter housing and also at the outlet opening for filtered fluid. By means of protruding control lugs which are provided on the fluid connections of the fluid means the spring-loaded blocking bodies of

these valves can be moved automatically against the closing force into the open position, when the filter housing is mounted on the fluid means (specifically the tank). Since in these embodiments when the filter housing is removed from the fluid means the openings of the filter housing are automatically blocked without having to take precautions against unintentional escape of fluid from the filter housing, it can be moved to another location in order to have the filter element changed elsewhere, and then additional maintenance actions can still be undertaken.

Other advantageous embodiments of the filter device as claimed in the invention are the subject matter of the other dependent claims.

The invention will be detailed below using one exemplary embodiment as shown in the drawings.

- FIG. 1 shows a longitudinal section of a hydraulic tank with a filter device built into a tank compartment according to one embodiment of the invention, the filter device being in the operating state;

- FIG. 2 shows a top view of the hydraulic tank from FIG. 1;

- FIG. 3 shows a section similar to FIG. 1, a tank cover enabling access to the tank compartment being opened and the filter device for removal from or installation in the tank compartment being shown in a rotary position which is turned by 90° relative to FIG. 1;

- FIG. 4 shows a top view of the tank from FIG. 3 which has an opened tank cover;

- FIG. 5 shows a section of the area designated I in FIG. 1 drawn on a larger scale compared to FIGS. 1-4;

- FIG. 6 shows a perspective of the connecting plate of a fluid means (hydraulic tank) with the assigned embodiment of the filter device, the filter housing being dismounted from the connecting plate with the fastening device released.

FIGS. 1 to 4 show a fluid means in the form of a hydraulic tank 1 with a separate tank compartment 3 which is built into it and which can be connected to the remaining tank contents simply by way of the fluid connections 5 and 7, but otherwise is sealed relative to the remaining tank contents. The fluid connections 5 and 7 are located on the bottom-side termination of the tank compartment 3 which is formed by a flat connecting plate 9. The connecting plate 9 forms the carrier for the filter housing 11 of the filter device as claimed in the invention which can be attached to the plate by means of a detachable fastening device. For the filter housing 11 which is in the operating position and which is attached to the connecting plate 9 the fluid connection 5 forms the inlet for supply of the fluid to be cleaned to the dirty side in the interior of the filter housing 11, while the outflow of cleaned fluid after it has passed through the filter element 13 in the filter housing takes place through the fluid connection 7.

FIGS. 1 and 2 show an operating state in which the filter device with the tank cover 15 closed is installed in the tank compartment 3 and the filter housing 11 is located in the position corresponding to the operating state of the device. This operating state is shown more clearly in FIG. 5. As is to be seen, the filter housing 11 is locked to the connecting plate 9 by means of a bayonet catch which has a bayonet ring 17 which is attached to the connecting plate 9 (see also FIG. 6) and which interacts with the bayonet ribs 19 (FIGS. 5 and 6) diametrically opposite one another and which bayonet ribs radially project on the assigned end edge of the filter housing. In the rotary position of the filter housing 11 shown in FIG. 6, the bayonet ribs 19 can be inserted into the bayonet guide of the bayonet ring 17 by way of recesses 21 (FIG. 6). By turning the filter housing 11 out of the rotary position shown in FIG. 6 by 90 angular degrees, the filter housing 11 is locked

to the connecting plate 9 by means of the bayonet catch 17, 19. This rotary position which corresponds to the operating state of the filter device is shown in FIGS. 1 and 5, while FIGS. 3 and 6 show the rotary position in which with the bayonet catch released the filter housing 11 can be lifted off the connecting plate 9. The filter housing 11 is closed on the end side by a cover part 23, from which a handle 25 designed for manual turning of the filter housing 11 extends axially away from the cover part 23 (to the top in the drawings). As a comparison of FIGS. 1 and 3 shows, the tank cover 15 can only be closed by the axial projection of the handle 25 in the rotary position of the filter housing 11 which corresponds to the operating state when the bayonet catch is locked, specifically when the corresponding section of the handle 25 extends along an arched recess 27 in the tank cover 15. If on the other hand the filter housing 11 is in the rotary position shown in FIG. 3, where the projecting section of the handle 25 extends transversely to the recess 27 and accordingly the tank cover 15 cannot be completely closed, the operator is signaled by suitable means that the filter housing is not locked properly by means of the bayonet catch and the filter device is therefore not in its operating state.

As FIG. 5 shows most clearly, in this operating state passages 29 and 31 of the rotary disk valve 33 are flush with the fluid connections 5 and 7. The rotary disk valve 33 is pivoted on the pin of a collar screw 35 which has been screwed into the connecting plate 9. The rotary disk valve 33 has connecting sleeves 37 and 39 which continue the passages 29 and 31 into the interior of the filter housing 11 and which penetrate the inlet opening 49 of the filter housing 11 and the outlet opening 43 of the filter housing 11. The inlet opening 41 through which dirty fluid enters the filter housing 11, and the outlet opening 43 through which cleaned fluid emerges form the filter housing 11, are located in the bottom part 45 of the filter housing 11. The bottom part 45 is sealed relative to the connecting sleeves 37, 39 by O rings seated in annular grooves 63 (not shown) and relative to the surrounding wall of the filter housing 11 by O rings seated in annular grooves 65 (not shown).

When the filter housing 11 is turned out of the operating position shown in FIGS. 1 and 5, the turning bottom part 45 entrains the connecting sleeves 37 and 39 of the rotary disk valve 33 acting as rotary drivers, so that it is turned and its openings 29, 31 become unaligned with the fluid connections 5 and 7. When the rotary position of the rotary disk valve 33 shown in FIG. 3 is reached, the fluid connections 5 and 7 are sealed by the rotary disk valve 33. In this position which is turned by 90° relative to FIGS. 1 and 5 and which is suggested in FIG. 6, the bayonet catch 17, 19 is released so that the filter housing 11 can be lifted. While for the operating position shown in FIGS. 1 and 5 the control lugs 47 which project on the end of the connecting sleeves 37 and 39 into the interior of the filter housing 11 have held open the blocking bodies 49 of blocking valves 51 and 53 against the closing force of assigned closing springs 55 and 57, by lifting the filter housing 11 the blocking bodies 49 now are placed against the valve seats 59 and 61 by the closing springs 55, 57 in order to close the inlet opening 41 and the outlet opening 43 of the valve housing 11.

Thus, the filter housing 11, when it is dismounted from the connecting plate 9, is secured against escape of fluid, so that the filter housing 11, without the danger of environmental pollution by escaping leaking fluid, can be safely transported for replacement of the filter element or other maintenance. When a filter housing 11 containing an unused filter element 13 is moved onto the connecting plate 9 so that the bayonet ribs 19 enter the bayonet guide of the bayonet ring 17 through the recesses 21, the connecting sleeves 37, 39 of the rotary disk valve 33 penetrate the inlet opening 41 and the outlet opening 43 of the valve housing so that the projecting control lugs 47 unblock the blocking bodies 49 of the valves 51 and 53. If then the filter housing 11 is turned 90° for locking of the bayonet catch, the rotary disk valve 33 reaches the rotary position shown in FIGS. 1 and 5, so that in the course of attaching the filter housing 11 to the connecting plate 9 a fluid connection to the tank contents is automatically produced. On the other hand, when the filter housing is turned 90° to release the bayonet catch, the fluid connection to the tank contents is automatically blocked when the rotary disk valve 33 assumes the position shown in FIG. 3.